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ABSTRACT

The purpose of this research study was to determine whether a specific information problem-solving skills model was an effective metacognitive scaffold for students solving information-based problems. Specifically, 35 eighth grade students in two intact classes were asked to write newspaper articles that summarized the events surrounding the Selma March during the African-American Civil Rights Movement. Achievement and attitudinal data were collected at the end of the treatment period, and observational data were collected throughout the treatment period. One class of students followed the procedures of the Eisenberg and Berkowitz Information Problem Solving model while the other followed the procedures provided by the classroom teacher. Results revealed that the students following a specific metacognitive scaffold performed better on the achievement measure. However, the students using a teacher-managed process reported more positive attitudes than the scaffolded students. Possible reasons for the differences in reported attitudes between the two groups include differing responsibility levels of students and teachers within the groups as well as differences in time spent in on-task behaviors throughout the study. (Contains 36 references.) (Author/AEF)

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USING THE BIG SIX INFORMATION SKILLS AS A Metacognitive Scaffold TO SolvE Information Based Problems

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Abstract

The purpose of this research study was to determine whether a specific information problem-solving skills model was an effective metacognitive scaffold for students solving information-based problems. Specifically, thirty-five eighth grade students in two intact classes were asked to write newspaper articles that summarized the events surrounding the Selma March during the African-American Civil Rights Movement. Achievement and attitudinal data were collected at the end of the treatment period, and observational data were collected throughout the treatment period. One class of students followed the procedures of the Eisenberg and Berkowitz Information Problem Solving model while the other followed the procedures provided by the classroom teacher. Results revealed that the students following a specific metacognitive scaffold performed better on the achievement measure. However, the students using a teacher-managed process reported more positive attitudes than the scaffolded students. Possible reasons for the differences in reported attitudes between the two groups include differing responsibility levels of students and teachers within the groups as well as differences in time spent in on-task behaviors throughout the study.

Introduction

Information literacy has been a topic of research for a number of years. Through the examination of searcher behavior, several models have been developed that describe the processes used by people who are seeing information (Eisenberg & Berkowitz, 1990; Kuhlthau, 1983; Stripling & Pitts, 1988). Organizations such as the American Association for School Librarians and the American Library Association have collaborated to develop standards for information literacy. These standards call for students who access information efficiently and effectively, evaluate information critically and competently, and use information accurately and creatively (American Association of School Librarians, 1998). Students who use information in this manner to explore and solve problems are identified as being information literate. It has been noted that students need various resources, tools and scaffolds to support their efforts to solve the educational problems they encounter (Hannafin, Land, & Oliver, 1999; Hannafin, Hall, Land, & Hill, 1994). The role that scaffolding plays in student achievement has also been explored (Saye & Brush, 1999; Hannafin et al., 1994; Hannafin, Hannafin, Land, & Oliver, 1997a). This study sought to enrich the body of knowledge concerning the role of metacognition and metacognitive scaffolds in supporting student research activities.

Metacognition

Metacognition has been described as thinking about thinking. More specific definitions include references to knowledge and control of factors that affect learning, such as knowledge of self, the task at hand, and the strategies to be employed (Baker & Brown, 1984; Palincsar & Brown, 1981). In order to perform metacognitively learners must be able both to be aware of their own cognitive activities, and to control and monitor that cognitive activity. The distinction between awareness and control was examined in order to determine what differences existed between learning disabled and non-learning disabled students. Slife, Weiss, and Bell (1985) found that when these two groups of students were compared in metacognitive skill activities, the differences were in metacognitive strengths rather than skills deficiencies.

McGregor (1993) examined the thinking processes that students engaged while writing research papers. She found that students seemed to be unaware of their own cognitive processes. That is, "students do not instinctively operate in a metacognitive manner" (McGregor, 1993 p. 131). Other researchers have found that student success in a learning environment is impacted by the lack of metacognitive ability of the students (Hill, 1995; Land & Hannafin, 1997). This lack of metacognitive skill and awareness supports the need for instruction

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that teaches learners to "plan, implement and evaluate" (Palincsar, 1986 p. 123) strategies for learning and problem-solving.

Scaffolding

How can teachers provide the instruction students need in order to develop strong metacognitive skills that are inherently difficult both to observe and teach? One way is to incorporate the use of scaffolds into the curriculum. While the basic concept of scaffolding has been defined as a support structure for learners engaged in activities just beyond their independent abilities (Vygotsky, 1978), some have further delineated differences between specific types of scaffolding. Hannafin et al. (1999) identified four different types of scaffolds, metacognitive, procedural, conceptual, and strategic. Figure 1 provides an overview of these scaffold types and the situations where they might be used.

Scaffold Type	Description	Used when...
Metacognitive	Guidance in what to think during a learning activity	Students are engaged in an independent metacognitive activity such as research-based problem solving
Procedural	Assistance with a particular tool or feature of a learning environment	Technology is being utilized; job aids are needed
Conceptual	Assistance with what to consider; Vygotskian scaffolding	The various possible methods for achieving success can be known ahead of time by the teacher
Strategic	Guidance in the approach that might be needed in a learning situation	Alternative strategies have not been considered by students; participation in planning and implementing decision making skills in open-ended learning environments.

Figure 1. Scaffold descriptions and uses

Research indicates that how scaffolds are used in various learning situations has impacted student achievement and attitudes (Saye & Brush, 1999; Hill, 1995; Krajcik, Soloway, Blumenfeld, & Marx, 1998). For example, Oliver (1996) and Brush and Saye (2000) both found that the use of a scaffold rather than its presence impacted student success within a particular learning situation. Other researchers (Hill, 1995; Land & Hannafin, 1997) suggest that deficiencies found in student metacognitive skill could be mitigated through the use of strong metacognitive scaffolds. In addition, the school library community has recognized the need for students to posses strong metacognitive skills.

Information Problem-Solving

Within the school library media community several researchers have studied searcher behavior in a variety of contexts, including print (Dreher, 1993; Dreher & Sammons, 1994), Electronic (Marchionini, 1989), and multimedia (Perzylo & Oliver, 1992) environments. Others sought to describe the search process in descriptive (Kuhlthau, 1993), and prescriptive (Eisenberg & Berkowitz, 1990; Stripling & Pitts, 1988) ways.

A common theme through the research on information seeking involves the need to increase the metacognitive skills of students. A general metacognitive scaffold is needed so that students do not have to rely on situation specific scaffolds each time they encounter a problem or unfamiliar situation (Costa, 1984). Several information problem-solving models exist (Kuhlthau, 1983; Stripling & Pitts, 1988; Eisenberg & Berkowitz, 1988) that could function as metacognitive scaffolds. The Eisenberg and Berkowitz Information Problem-Solving (IPS) model is well suited for use in this capacity. Figure 2 provides an illustration of the IPS model. Each step or task is comprised of two sub-tasks that students should accomplish in order to use information in an effective and efficient manner to solve educational problems.

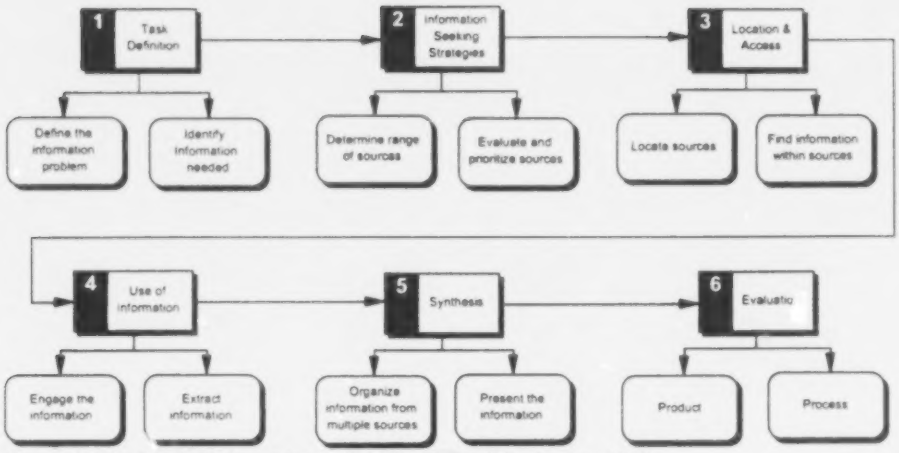

Figure 2. The Big Six Information Skills (Eisenberg & Berkowitz, 1990)

Integrating Scaffolding, Metacognition and IPS

The implementation of an information problem-solving model involves more than teaching students a series of steps and directing them to the research materials in the library. In order for learning to occur in these situations, students must actively interact with materials and information in such a way as to construct their own meaning from the interaction (Kuhlthau, 1993). However, as has been previously noted, this does not always occur particularly with student who are unfamiliar with the research process (McGregor, 1993; Perkins, 1991; Steinberg, 1977, 1989). However, if the "purpose of strategy instruction is to influence how the learner interacts with the learning situation" (Palincsar, 1986 p. 118), then the use of IPS as a metacognitive scaffold is warranted.

There are many references to the Eisenberg-Berkowitz IPS model on the World Wide Web and in the literature read by professional school library media specialists. While this body of anecdotal evidence is compelling as to the far-reaching effects this model has had on educational practices, it is lacking in rigorous research to support the conclusions presented. The only research that discusses the impact this IPS model might have on student achievement was conducted by the authors of the model (Eisenberg, 1999; Eisenberg & Berkowitz, 1998). This case study reported an improvement from 53% to 95% of students passing a high school American History examination over a period of one year.

While a variety of research has been conducted in order to understand the information seeking behaviors of searchers (Kuhlthau, 1991; Marchionini, 1989; Stripling & Pitts, 1988) and there has been an identified need to strengthen metacognitive skills in students (Hill & Hannafin, 1997; Brush & Saye, in press; Oliver & Perzylo, 1994) a detailed examination of the effectiveness of particular information problem-solving models has not been conducted. If a particular model were shown to be effective in strengthening metacognitive skills in students several of the performance gaps identified in research could be addressed. Students would effectively and efficiently access and use information, students would monitor their own thought processes, teachers would design effective scaffolded problem spaces, and students would begin to transfer problem-solving skills from one academic situation to another.

Method

Thirty-five students in two eighth-grade social studies classes in a major southwestern city participated in the study, divided equally between male and female genders. The researcher acted as both participant and observer during the course of the study by conducting one of the classes for the students and providing technical support for the participating teacher while he conducted his class. The participating teacher conducted the other class for the study according to his established classroom procedures. Students in this study were provided with their own computer (either a laptop or a desktop system) to use for research activities.

A two group (scaffolded vs. non-scaffolded), quasi-experimental design was implemented to determine achievement differences within this study. One group (scaffolded class) received training and guidance in the use of a specific IPS model while completing their reports and the other group (non-scaffolded class) received no explicit IPS training. Each student completed a 15 item, multiple choice pre-test prior to the onset of the study. Items covered knowledge-level information about the Selma March as well as the African-American Civil Rights

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Movement. Subject matter content was delivered via *Decision Point!* (DP), an "integrated set of multimedia content resources and tools" (Saye & Brush, 1999, p. 11) relating to the African-American Civil Rights Movement. Restricting the activity to a single event allowed the researcher to control the problem space students engaged while allowing students relative freedom to explore an even however they deemed appropriate (Oliver & Perzylo, 1994; Saye & Brush, 1999; Yang, 1997). The researcher created job-aids for all participating students to use during the study activities. These procedural scaffolds (Hannafin et al., 1999) helped students maintain focus and remain oriented in the open-ended environment.

Students in the scaffolded class were provided with an additional job-aid to remind them of the steps involved in the information problem-solving process (see figure 1). Some elements of this metacognitive scaffold were incorporated directly into DP through the "guides" and "journal" tabs of the electronic notebook. While these scaffolds were available to all of the students, only the students in the scaffolded class were explicitly told to use them. "Guides" questions consisted of a series of questions organized around the five questioning words associated with news article writing (who, what, where, when, why). The journal contained prompts for the students to complete that provided guidance in thinking about their own progress, and in making a plan for the next class meeting day.

The study was conducted over 11 class days, with one additional class day being used for the administration of the study pre-test. The participating classes met on alternating days, beginning each Monday. Classes that met on Monday or Wednesday lasted 85 minutes, while classes that met on Friday lasted 35 minutes. Prior to the beginning of the study one of the classes was chosen to receive the scaffolded activities. The other class received instruction that the classroom teacher designed and felt was appropriate for the unit as a whole.

One week prior to the beginning of the study activities the researcher visited the classroom in order to acclimate herself to the regular activities for each class. During this week the researcher administered the pre-test to the students. Although the scaffolded class scored slightly higher (M=4.5) than the non-scaffolded class (M=4.0) a Mann-Whitney analysis of the pretest scores indicated that there were no differences in prior knowledge between the two groups, $U(18,17) = 116.50$, $p = .36$. Upon completion of the pretest, an introductory activity was conducted with both classes. The activity consisted of a short scavenger hunt using the DP software. This helped insure that students were familiar with the basic components of the event that they investigated as a part of their final activity. After completion of the scavenger hunt, the structured unit activities began.

Each class received a different first activity to begin the study. The first activity for the scaffolded class was an information problem-solving training session. The orientation focused on the IPS process students were asked to engage during the study activity. The first activity for the non-scaffolded class was an introduction to newspaper article writing, conducted by the teacher. Once each class completed their orientation activities, the students spent three class days collecting information related to the Selma March and creating their initial (rough-draft) reports. They were given two class periods to make final revisions to their work. Students in the scaffolded class determined their own methods of information gathering with only mild guidance from the researcher.

Students in the scaffolded class began their study activities by determining exactly what was being asked of them. They then generated lists of questions that they could use to answer and fulfill their article requirements. Once the questions were generated students sued the DP database to find answers to their questions. They also used the questions in the Guides section of the DP notebook to focus their research. Once the students finished answering their own questions and those featured in the guides questions, they used that information to create a handwritten rough draft. Students then used the scoring guide to evaluate their neighbor's article. Students took those comments and made revisions to their work and submitted the final form of their article. The teacher guided his students during the newspaper article writing process according to established classroom procedures. After the initial introduction to the structure of news articles the classroom teacher told his students to "find the information you need in order to write your articles." Students turned in handwritten rough drafts that the teacher took home to edit. The next class period, he returned the rough drafts to the students so that they could make the indicated changes. Students turned in their final copies with an attached picture on a separate piece of paper.

The articles that the students created were news articles that reported on the events surrounding the Selma March. Students in both classes submitted the reports in written format. As a part of the IPS scaffold, students in the scaffolded class were given the criteria for grading prior to their submission of the assignment. The reports covered the following elements of the Selma March: a general overview or timeline of events, key people involved in the event, causes of the event, and results of the event. Observers took field notes and audiotaped each class session in order to collect qualitative data concerning student engagement, attitudes, and behaviors during the information problem-solving process. After each of the classes the teacher and researcher conferred for a short debriefing session. During this time the teacher had the opportunity to discuss any significant occurrences that the researcher may have missed during the class session and share his impressions of student attitudes and progress.

All of the students participating in the study completed exit surveys during the final class period. The 4-point Likert-type survey collected attitudinal data from the students, such as the students' feelings about the unit, the topic, their preferred way of learning social studies information and their feelings about future research projects. In addition, students were asked to respond to open-ended questions regarding the elements of the project they liked and disliked as well as whether they would recommend the project to their peers. Following the submission of student reports the researcher conducted exit interviews with selected students. The classroom teacher recommended students for selection based on their willingness to be interviewed and their ability to express and elaborate on their thoughts. The interviews were conducted in pairs to help alleviate any anxiety associated with the interview process as well as to gain a more complete understanding of what the student knew regarding the research study (Graue & Walsh, 1998). Interview questions were based on journal entries and observations from class sessions. Students were asked to explain and expand on comments made in their journals, to verify assertions made during classroom observations, and to give their opinions about the study activities.

Two neutral scorers used the evaluation rubric to assign scores to each report. To help ensure inter-rater reliability each scorer independently scored each report and then compared their ratings. If the scores were highly divergent the researcher conferred with the scorers to clarify any confusion about the rubric, and how to interpret student reports so that subsequent grading would have a higher level of agreement between the two scorers. At the conclusion of this procedure the correlation between the two groups of scores was .91.

Results

Both quantitative and qualitative data were collected during this study. Results as they pertain to data types are discussed below.

Newspaper Articles

A Mann-Whitney test of the report scores revealed that there were significant differences between the report scores for students in the scaffolded (N = 18, M = 12.72, SD = 1.64) and the non-scaffolded (N = 15, M = 11.00, SD = 1.36) classes, $U(18,15) = 61.00$, $p<.01$.

Student Questionnaires

Table 1 provides an illustration of student responses to selected questions from the attitude survey ($N_{non-scaffolded}=17$, $N_{scaffolded}=18$). Responses were provided on a four point Likert-type scale and then coded as either agree or disagree for analysis purposes. Chi-square analyses were conducted on each item to determine differences in attitudes. There were significant differences in the attitudes of the two classes regarding items "I felt smart while doing the project," $\chi^2(1,N=35)=6.89$, $p<.01$ and "I would like to do more projects like this on other social studies topics" $\chi^2(1,N=35)=5.93$, $p<.05$. There was also consensus on several other survey items. The majority of students in both classes disagreed with the statements: "This project made me feel nervous" and "This project made me feel dumb." Also, the majority of students in both classes agreed with the statements: "This project helped me understand The Civil Rights Movement better than if I had just read about it in my textbook," "I felt comfortable researching topics I know little about," and "I felt comfortable writing my newspaper article about the Selma March."

Open-ended questions asked students to provide for the researcher things they liked best and liked least about doing the project; ways to improve the assignment; things they would have liked to have more time to do; and whether they would recommend this project to other eighth grade students. Students from both classes liked the computers and the software that they used for their activities. The next most popular answer was that they liked learning about the Civil Rights Movement. These answers included responses referring to the era, the decade, or the event. Other comments included references to the lack of homework during the unit activities, the format of the product they produced and being able to do something different, or at their own pace. However, the scaffolded class mentioned the research process in greater numbers than did the non-scaffolded class.

When asked what they liked least about the unit, the most common answer from both classes concerned the physical act of writing the paper. Students were unable to use a word processor to write their papers because 14 of the 18 students in each class were using laptop computers that wee not connected to the single classroom printer. There were also two sets of students who did not like aspects of the technology used and aspects of having observations conducted in their classrooms. Most students in both groups responded that they would recommend this project as well as similar ones to other eighth grade students. Their reasons ranged from "because it was fun and interesting" to "it is an important event for people to learn about."

Table 1 Student Attitudes

	Class				
	Scaffolded		Non Scaffolded		
Statement	Agree	Disagree	Agree	Disagree	χ^2
This project made me feel nervous.	11.1% (2)	88.9% (16)	11.8% (2)	88.2% (15)	.00
I felt smart while doing this project.	38.9% (7)	61.1% (11)	82.4% (14)	17.6% (3)	6.89**
This project helped me understand The Civil Rights Movement better than if I had just read about it in my textbook.	77.8% (14)	22.2% (4)	88.2% (15)	11.8% (2)	.67
I would like to do more projects like this on other topics in social studies.	50% (9)	50% (9)	88.2% (15)	11.8% (2)	5.93*
I felt comfortable researching topics that I know little about.	83.3% (15)	16.7% (3)	82.4% (14)	17.6% (3)	.01
I felt comfortable writing my newspaper article about the Selma March.	76.5% (13)	23.5% (4)	82.4% (14)	17.6% (3)	.18
This project made me feel dumb.	11.1% (2)	88.9% (16)	11.8% (2)	88.2% (15)	.00

*$p < .05$; **$p < .01$

Classroom Observations

During periods of direct instruction, students in both classes demonstrated their understanding of the proper behavior of a school classroom. They raised their hands, tended not to speak all at once, and listened to the comments of their classmates. Also, when they knew the answer to a question from a classmate they were fairly quick to answer and provide help.

During periods devoted to research activities students in the scaffolded class exhibited behaviors that suggested they were more self-directed in their activities. Students in the non-scaffolded class, however, spent the majority of their writing time traveling back and forth between their desks and wherever the teacher was standing. They were less willing to make decisions on their own and relied on the teacher to do the majority of their editing.

Students in both classes asked many questions that were focused on the technology of the DP database. These questions ranged from "Why don't my movies plan?" to "How do I get to do the typing party?" Any questions of this type were answered by the researcher, regardless of which class was in the room. Most of the comments made by students in the non-scaffolded class were directed at the teacher. Usually, a student would ask the teacher to review a sentence or paragraph that had just been written and wait for specific feedback from him. Comments between students generally were initiated only when the teacher was extremely busy, and were superficial in nature. For example, a common question students would ask each other was "how do you spell..." Also, they would ask their neighbor how to find a particular video or picture that was displayed on their computers or ask for help with technical issues on the CD-ROM. The majority of the comments directed to the teacher had to do with the physical construction of their final products. Students asked the teacher to "check-over" each sentence as they wrote them. Sometimes, students would ask the teacher to hold their papers and call them when he had finished with the ones ahead of them in line. Students who used his technique for holding their place in line were observed talking about movies, parties, homework assignments from other classes, and other topics that had nothing to do with the Selma March. Once the students reached the teacher the most frequently asked question was, "Is this ok for a lead/title/sentence?"

Students in the scaffolded class also asked each other spelling and technical questions, but they interacted with each other in terms of the content they were exploring. One student was heard to ask, "Who was this Lyndon Johnson?" The reply was, "Duuuhhh, he was the President during all of this stuff!" Students sitting next to each other were observed talking about the information they found in the articles they read during the activity. Usually this was in connection with a question they asked the researcher about specific information they did not understand, or had difficulty finding within the CD-ROM. Students also discussed the social issues they were finding in the videos and articles of the DP database. Two students were heard discussing the video of the attack on the marchers at the Edmund Pettus bridge. They discussed how the video demonstrated elements of racism based on the attacking dogs and police officers only "going after" the African-American people.

During the final portion of the activity the students in the scaffolded group were asked to review their neighbor's reports. Comments during this activity were centered around the structure of the article itself. Several students were heard to say "the green guide [scoring guide] says that you have to have six paragraphs, and you only have one," or similar types of comments. No comments were made about spelling or grammar, only about the physical layout of the articles.

During the two class periods designated as primarily research days the noise level in the class was markedly lower than during any other days during the study. Students in both classes were observed intently viewing their computer screens. The students in the non-scaffolded class were also using notebook paper and pens to take notes. However, these students were observed copying directly (verbatim) from the articles onto their papers. For the most part, students worked independently. Brief comments were made between table partners, but the research process was primarily conducted on an individual basis. Students in the scaffolded class were typing directly into the computer. Upon observation, these students were typing the answers to the Guides questions that were incorporated into the DP database. Usually, their answers were typed in a list format. For example, one of the Guides questions was, "who was involved in this event?" A typical student's entry would be, "MLK, black voters, federal judge, Jimmie Lee Jackson, President Johnson." Some students were seen to be working together to gather the information for their Guides.

Student behavior on the days designated for writing rough drafts was different between the two classes. The students in the non-scaffolded class alternated their activities between writing one or two sentences at a time and waiting for the teacher to check their work. As a result, there were many students walking around the room during this period of time. During the consultations with the teacher most students in the non-scaffolded class would get part of a question out and then the teacher would interrupt and finish it, or provide the answer to their question without letting them finish. Many times, the teacher would write directly on the students' papers with the wording that he wanted them to use and they would copy it verbatim into the next revision of their article. In most cases the teacher was in possession of the student's paper and pencil during these consultations.

These behaviors contrast with those observed during the scaffolded class. During the days designated as writing days, these students were observed going back and forth between the computer and their papers. While they did consult with the researcher, she maintained a different relationship with the students than observed in the non-scaffolded class. When students asked, "Is this an ok title?" or "Is this all right so far?" the researcher replied, "You have a copy of the exact scoring guide that I will use to give you a grade on the article. You can make those decisions yourself." After answering approximately half of the class' questions like this, the types of questions shifted to content-oriented or technologically-focused ones. During the final evaluation activity for the scaffolded class, the noise level increased, but upon observation this was due to increased occurrences of debate between students. During this activity students were more likely to consult with the researcher to clarify the elements of the scoring guide. After the peer evaluation, students made any corrections to their work that they felt were necessary.

Interviews with the teacher revealed that he thought the unit was generally a success for both classes. He said, "I thought they were interested and engaged." He also noted some differences between the two classes such as attitudes of specific students, time spent in on-task behaviors, and the quality of the work submitted by the students.

Two of the students in the researcher's group were seen by the teacher to be exceptionally interested and engaged with the material. One of these students exhibited what to the teacher was unusual maturity during the completion of the project. Usually this particular student failed to work up to his potential and maturity level, yet still managed to get fairly good grades in school. This student's attitude stood out to the teacher because it was so different from his normal behavior. Other students demonstrated differences in their behavior as well. One student voiced her concern over the quality and correctness of her work to the classroom teacher. "Her paper's decent; it's not great, but she normally, if she doesn't understand, her defense mechanism is to laugh it off and screw around...But she acted like she wanted to do this or was concerned about am I doing this right? Is this good?" A difference the teacher noticed between the two groups was their time spent on-task during the research assignment. "Your group was a little more on task as a whole than mine," said the teacher. He attributed this difference to the difference in presentation styles between himself and the researcher.

The teacher also thought that the quality of the student reports was different between the two groups. Prior to evaluation of the final reports, the researcher asked the teacher to predict whether or not there would be differences in the scores between the two classes. The teacher predicted that the quality of the students in the scaffolded class would be higher than in the non-scaffolded class. He felt that the steps of the information problem-solving model provided a structure that was detailed in such as way as to make failure difficult to achieve.

Overall, the students interviewed from both classes felt that their experience with the unit was a positive one and that they would do something like this again, that the teacher should have provided an overview of the Selma March, and that they wished the content of the news articles were organized chronologically rather than by information type. Differences in attitudes between the two classes were expressed through their perceptions of the newspaper article assignment, what made the unit fun, the role of the teacher, and the types of information within the DP database. The students in the non-scaffolded class felt that writing newspaper articles was a good way to process information and demonstrate their understanding of a topic, but did not like to do it. When the researcher asked students from the non-scaffolded class how they would improve the unit, they focused on providing their

teacher with an assistant. They felt that the teacher was overextended during the study activities. They also spoke strongly about having to wait for long periods of time to get their questions answered about their articles. This paralleled the responses on the exist surveys where one student stated "It would have been better if [the teacher] had time to answer everyone's questions."

Students in the scaffolded class mentioned different aspects of the unit during their interviews. Their comments tended to focus on the research process and differences in the types of information they encountered while conducting research for their newspaper articles. These students indicated that the implementation of the unit was cumbersome to them. They would have preferred to have a single sheet of paper to follow rather than the packet that was provided for them. They also indicated that the steps [of the IPS model] were generic enough that they would try to use them in other classes for other research projects. Students from the scaffolded class also noted that the nature of the information they explored was different than the information they usually used during social studies classes. These students differentiated between the types, and value, of information found in primary sources and in textbooks. They did this despite not having had class discussions about differences between primary and secondary sources. For these students, the primary source documents provided more authentic and accurate information than their textbooks.

Discussion

Using specific information problem-solving models as metacognitive scaffolds has not been widely studied. This research suggests that a particular information problem-solving model might act as an effective metacognitive scaffold for students engaging in complex research-based activities.

Results showed that students who completed research writing activities (newspaper article creation) supported by the IPS model created newspaper articles that were more accurate, utilized a wider variety of information resources, and contained richer details than students who did not have this support. Achievement scores between the two classes of students differed significantly, with the mean achievement score for the scaffolded class being nearly two raw score points higher than the non-scaffolded class. In addition, this study showed that the use of an information problem-solving model increased student engagement, but may have affected the attitudes of students.

There are two potential reasons for the significant differences found in student achievement scores: increased metacognitive activity and differences in time-on-task between students in the scaffolded class and students in the non-scaffolded class. Metacognitive skills such as task analysis, strategy selection, and self-monitoring were strongly supported for students in the scaffolded class. Students in the non-scaffolded class relied on their teacher for support in these tasks, rather than executing the processes themselves. This is illustrated by the role the classroom teacher assumed for his students. The teacher's proposed role, that of "editor-in-chief," was demonstrated while his students were writing their rough and final drafts of their articles. Each student approached the teacher to get his final approval on each sentence or paragraph as they wrote it. This contrasted with the scaffolded class where the students received their guidance and support from the scaffold that the researcher provided to them. Each of the six information problem-solving steps was provided to the students in a booklet that they could use to monitor their own progress. Additionally, it provided them with an explicit process to follow in completing their work. Students in the scaffolded class knew exactly what to do while students in the non-scaffolded class had to ask their teacher for direction at each step of the writing process.

Researchers have claimed that students who can successfully analyze tasks, identify strategies for task completion (Palincsar & Brown, 1981), apply problem-solving strategies in appropriate situations (Eisenberg & Berkowitz, 1990; Palincsar & Brown, 1981) and engage in self-monitoring behaviors (Bondy, 1984) can be considered metacognitively successful. However these skills are difficult for children to acquire (Brown, 1985). Bondy (1984) makes several recommendations to educators interested in strengthening students' metacognitive skills. These include: (1) modeling metacognitive strategies in order to provide students with an understanding of how to mentally negotiate difficult cognitive tasks, (2) requiring students to keep a daily learning log to shift the cognitive focus from product to process, (3) providing instruction in self-questioning techniques to redirect attention, and (4) adapting a learning and studying model to assist students in applying strategies in a wide variety of situations. The relationship between the IPS model and metacognitive skills discussed in the literature was illustrated through the data acquired in the current study.

Gradually, students in the scaffolded class began to understand that the steps of the IPS model could help them understand where they were supposed to be at the end of each day, and where they were supposed to start at the beginning of the next day. Journal entries confirmed this. Except for one student who exhibited extremely high levels of anxiety in relation to the assignments, most students indicated that they were either moderately or highly confident that they knew what to do the next day. Eisenberg & Berkowitz (1988, 1990) argue that the Big Six

Information Skills is a model that students and teachers can use in learning, studying, and problem-solving situations. As such, it can be utilized as a learning or studying model, as recommended by Bondy's (1984).

The second possible explanation for the significant differences in achievement scores was the time-on-task students demonstrated in each class. Due to the more highly defined path and the more frequent opportunities to check their work, students in the scaffolded class spent more time on task, rather than waiting for feedback from their teacher. This may have been due to the fact that the procedures in the scaffolded class provided a pre-defined structure for students to follow while completing their study activities. This structure included opportunities for peer feedback and personal reflection on the quality of their work. The procedures students were to follow were provided in written form. This allowed students to know the next step and allowed the researcher opportunities to shift research responsibilities back to the students by having a tangible reference point available during discussions. Neither the students nor the teacher in the non-scaffolded class utilized this structure. Thus, these students needed much more hands-on guidance from the teacher.

Students from both classes sought out either the researcher or teacher for guidance during the activities. However, students in the non-Scaffolded class were more often waiting in line for their teacher's input, while students in the Scaffolded would frequently form groups to ask the researcher a common question. The classroom teacher assumed a high degree of control in his classroom. This contrasts with the role the researcher assumed for her class. She encouraged the students in her class to assume responsibility for the completion of their tasks, according to the methodology of the IPS. Consequently, engagement with the topic was higher for the scaffolded class. The increased level of engagement allowed students in the scaffolded class more time to create their initial article and to correct any mistakes or omissions in relation to the content of their articles. This supports prior research showing a correlation between time spent engaged in instructional tasks and increases in student achievement (Doyle, 1983; Montazemi & Wang, 1995; Van Dusen & Worthen, 1995).

The results in this study suggest that following the procedures of the IPS may have caused students to shift their mental focus from a procedural activity to an internal mental process (Bondy, 1984). Previous research on children's thinking processes has found that for some students the thinking process occurred without conscious direction on their part (McGregor, 1993). The students in the scaffolded class demonstrated that they were more aware of how their thinking affected the decisions they made. One student told the researcher, "I'm finished with the Information Seeking Strategies activity and will start my Use of Information activity tomorrow." Many students in the scaffolded class demonstrated this rudimentary identification of thought processes.

A second finding that is significant to educators is that the IPS might have an impact on student engagement with the topic. The benefits of increased engagement include increased time on task, opportunities for learning through repetitive exposure to material, readiness for higher-order thinking and opportunities for richer evaluation of student work (Newmann, 1992). By focusing the students' decision making on whether they are satisfied with the current situation and what they can do to change that situation, IPS strategies increase the opportunity for learners to become engaged.

Lastly, the IPS process did not increase anxiety levels for students in the scaffolded class. Students in both classes agreed with statements indicating generally positive feelings toward the study unit as a whole. Additionally, the classroom teacher liked the accountability the IPS scaffold provided for the students and the structure it provided to students. He stated that he would be willing to use it if he were to implement another unit of this type in his classroom.

When interpreting the results from this study, readers should consider that due to the unique population of participants and the following limitations the results presented are not generalizable beyond the current study. The teaching styles of the two adults in the classroom may have affected the results. The researcher acted as a participant in the study. As such, her biases and influences must be considered in light of the research question. The researcher did not have prior knowledge about the school performance of the students in the Scaffolded class. Therefore, her impressions of the students were based on what she observed during the implementation of the study. The classroom teacher had spent the entire school year with the students and had formed opinions about the students based on their performance over the previous six months. These differences in opinions concerning the students may have impacted the interactions between the teacher and researcher and the students in each class.

Implications

Prior research has found that one of the essential skills students must possess in order to be successful in problem-based learning activities is metacognition (Hill & Hannafin, 1997; Land & Hannafin, 1997). IPS models act as metacognitive scaffolds that support students while they become more adept at monitoring their own thought processes during the problem solving process. The structured vocabulary the IPS model provides allows teachers and students to label behaviors and clarify terminology, two activities that are recommended to enhance

metacognitive ability in students (Costa, 1984). Consequently, an unobservable process can be monitored and tracked through a set of prescribed steps and described using a standardized vocabulary.

In addition to shifting the focus of student metacognition from covert to overt, implementing the IPS model allows students to spend more time on task in a problem-solving situation. Increasing the time on task is likely to increase student achievement (Doyle, 1983; Montazemi & Wang, 1995). The IPS process provides a cognitive map for students to follow as they solve information-based problems. This map encourages students to assume ownership and responsibility for their problem-solving process. An added benefit of increased time on task is that students are exposed to the content involved with the problem situation more frequently. This may assist students in better comprehending the information relevant to their problem.

IPS models may provide overarching processes that students can employ in a variety of learning situations. The benefit of strengthened metacognitive skills is that students can then apply these skills to a variety of learning situations that may differ from the area in which the process was initially introduced (Bondy, 1984).

The results in this study provide support for a growing body of research suggesting that with appropriate support, students can succeed at complex, learner centered, research-oriented tasks (Brush & Saye, 2000; Eisenberg & Berkowitz, 1998; Hill & Hannafin, 1997; Land & Hannafin, 1997; Marchionini, 1989; Perzylo & Oliver, 1992). However, implementing a new process for completing activities in school might be difficult at first. Students may be uncomfortable with the accountability the IPS models place on them. By introducing the process in small steps and infusing IPS vocabulary throughout the school day, teachers can help students become more comfortable and skilled at implementing the metacognitive skills that are supported by this model.

Conclusion

Research suggests that implementing a process approach to research skills can be effective when certain conditions are met (Kuhlthau, 1993). These conditions include strong team-based planning and implementation activities, an emphasis on student engagement, and the presence of a collaborative learning environment. The current study suggests that a specific process, the Big Six Information Skills (Eisenberg & Berkowitz, 1988), might be effectively used as a metacognitive scaffold for students solving information-based problems.

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